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Small farm viability in Central America – can tools for smallholder decision-making play a key role?

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1 Introduction – Can small farm agroecological and business management be improved?

Traditionally small farms have faced complex resource allocation decisions of their scarce land, labor and financial capital to meet home consumption and income aspirations constrained by incomplete information access, including prices, and dependent on ecosystem services. With globalization and climate change, farm households also face stricter quality control and value chain certification, increasing environmental and business regulations, product and input price volatility, declining natural resource quality and increasing frequency of extreme weather events. Research and development organizations primarily address these decision challenges with single factor field-scale solutions – new varieties, agroforestry, crop diversification, IPM packages, value chain linkages, etc. In our own recent work on mixed crop – livestock – tree systems, we developed decision tools for coffee and banana pests, light partitioning in multi-strata systems and dry season feeding (e.g. Staver *et al.* 2014, Guharay *et al.* 2000). Farm households, each with their own array of resources and livelihood goals, face the challenge to evaluate alternatives from us and others and to decide how to reallocate resources to improve their farm enterprise. While diverse aspects of farm decision making have been studied (Kimi and Cameron 2013), whole enterprise management has seldom been the focus for small farm intensification (Alsos *et al.* 2011). When extension services address farmer management skills, they commonly focus on the improvement of input-output relations of specific production systems, a craftsman approach (Lans, Seuneke, Klerkx 2013) rather than on entrepreneurial decision tools for integrated farm intensifiction. Through the CGIAR Consortium Research Program Humid tropics which has a focus on integrated systems intensification, we began an initiative in Central Northern Nicaragua to develop small farm management tools applicable in three land use systems – coffee, cocoa and mixed annual food crops with cattle as a component of all three systems. We hypothesize that farm management and investment decisions can be improved through timely observation, recordkeeping, analysis and learning. This hypothesis is backed by studies from industry suggesting that management is a key element in business performance (Bloom, Sadun and Van Reenen 2012), although Barret, Carter and Timmer (2010) identify numerous external factors which affect farm household resource optimization in a complex and uncertain decision making environment with multiple livelihood goals and Pannell (2006) argues that response curves are relative flat in such an environment making gains from improved decision making minor. We propose that management tools should draw on three perspectives: 1) the farm as agroecosystemic structure and function organized in energy flows, nutrient and water cycles, food webs and biodiversity, 2) the farm as a livelihood system reflecting the interests, resources and social relations of household members and 3) the farm as a competitive enterprise in the market. In this paper we describe the approach and initial progress of a multi-phase effort with research and development partners and farmer organizations to prototype whole farm management tools for smallholders aimed toward integrated intensification.

2 Materials and Methods

Working in three different land use systems in Central Northern Nicaragua oriented towards either cocoa production (Waslala/Rancho Grande), coffee production (Jinotega/El Cua) or a mixed staple food crops and cattle (Esteli), we have initiated the following year by year approach to build a whole farm integrated management toolbox beginning with single field management tools:

1. Through learning alliances of rural development organizations, grower associations and research and education institutes in each land use zone, identify a small working group to assemble from experience and technical publications existing farmer-oriented observation and decision tools with a crop and cropping system approach;
2. With the small group, rework existing tools into a crop phase-based schedule of observation, scouting and monitoring taking into account soil and field conditions, crop density and vigor, presence of pest, disease and natural control mechanisms, labor and input use, involvement of household members in practices and decision-making, soil and weather conditions, etc. For each crop phase, key decisions in crop planning and practices are identified to be addressed with structured observations contributing to decisions to be made. Sampling strategies focusing on only a single aspect of production management such as pest scouting, nutrient status or fruit load were converted into a single sampling routine addressing the diverse aspects of integrated crop, pest and soil management

and costs for input and labor use. Pretesting of the observation routine was completed by the small working group.
3. Testing by farmers and field organizations of the observation and decision-making routine over a full crop cycle with regular meetings among farmers and field technicians to analyze functionality of sampling routines, quality of data and contribution to decision-making and patterns by production system status across multiple fields;
4. Once the field observational routine was underway, design of data entry, storage and access system to make data available in real time both to each farm household and as big data to the participating field organizations;
5. In parallel to field testing, studies to map whole farm agroecosystem structure and related livelihoods of household members to farm and off-farm enterprises, information intended to guide a shift from a field to farm perspective;
6. Evaluation workshop of results of year one and planning for multi-field sampling by each household in year two responding to question whether the observation-for-decisions approach can be applied beyond a single field;
7. Testing by farm household and field organization in year two of proposed observation and decision-making routine with regular meeting to analyze functionality of sampling routines, quality of data and contribution to decision- making and factors in production system status across multiple fields;
8. Evaluation workshop of results of year two and planning for household scale framework combining 3-5 production enterprise formats complemented with data annotation and analysis of food security, income flows, off-farm ecosystem service flows and trade-offs and synergies in decisions on the use of scarce resources;
9. Year three prototyping by farm household and field organization of proposed observation and decision-making routine focusing on whole farm;
10. Based on three years of data from 50 fields by production enterprise, development of scenarios on extreme weather events, pest and disease outbreaks and input and crop price fluctuations and the potential for reduced risk and greater livelihood resilience through modifications in the combinations and management of farm enterprises;
11. Based on farm scale data base with household member livelihoods mapped to farm and off-farm enterprises and follow up studies on hired labor livelihood strategies, analysis of potential for gender transformational alternatives in allocation of farm resources and the impacts of farm intensification on livelihoods of hired farm labor.

3 Results – Discussion

To date in year one with three working groups, the process of assembling dispersed tools into a crop-based observation and decision making routine has been completed for three crop enterprises - coffee, cocoa, maize-bean annual crop rotation - and grazed cattle. For coffee, the integrated tool addresses a mixed multi-strata coffee system intercropped with bananas building on two major sources of tools (Guharay *et al.* 2000; Staver *et al.* 2014). Key decision moments during the annual crop cycle were identified, existing tools were reviewed and diverse scouting approaches were reworked into overlapping and multi-purpose formats. Data are noted onto paper formats, summed in the field and then later entered into a data base. For cocoa, the integrated tool draws on a thematic toolkit which has been converted into six observation moments (http://programs.lwr.org/cocoatoolkit/resources) during the annual crop cycle for an established plantation. Diverse aspects of shade, cocoa phenology and pest and disease status are noted during a single scouting procedure and entered into a hand-carried tablet. Collaborating growers (50 for each crop) and technicians (5 for each crop) from their growers' associations have planned a year-long routine of field visits and meetings to test the tool. A subsample of these same households will be surveyed to characterize the whole farm context as an agroecosystem and map livelihoods to diverse farm and off-farm activities.

4 Conclusions

The process of visioning and assembling an integrated observation and decision-making tool for single field management has provided insights into the potential for small farm intensification. Initial lessons suggest that the process serves as a platform to integrate the experience and perspectives of field organizations, researchers and value chain actors. Challenges in year one are anticipated around the compilation and analysis of data in real time and the documentation of insights into the whole farm context that appear in single field management. A rich exchange is anticipated through the learning alliances based on the parallel experiences generated in the three land use contexts.

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